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NEW RECORDS OF THE DIPTERAN GENERA *TRIPHLEBA* (PHORIDAE) AND *PROSPHYRACEPHALA* (DIOPSIDAE) IN ROVNO AND BALTIC AMBERS

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New Records of the Dipteran Genera *Triphleba* (Phoridae) and *Prosphyracephala* (Diopsidae) in Rovno and Baltic Ambers. Perkovsky, E. E., Mostovski, M. B., Henderickx, H. — Dipteran insects constitute 51 % among arthropods of the Rovno Amber. There are 99 species and 23 genera of the Diptera described from the Rovno Amber; however, to date only 32 species are shared with the Baltic Amber fauna, including two species that are treated in this paper. *Triphleba schulmanae* Brown, 2003 (Phoridae), originally described from the Baltic Amber, is recorded in the Rovno Amber for the first time and its amended description is supplied. Genus *Prosphyracephala* Hennig, 1965 (Diopsidae), earlier known from the Baltic and Saxonian ambers, the Upper Eocene of Ruby River (Montana, USA) and the Lower Oligocene of Céreste (France), is recorded in the Rovno Amber for the first time. *Prosphyracephala* aff. *succini* (Loew, 1873) is the first diopsid record from Ukraine. A second specimen of *Prosphyracephala kerneggeri* Kotrba, 2009 is found in the Baltic amber; the complete wing venation is described for the first time for this species. Vast majority of the Old World Diopsidae are strictly thermophilous. In fact, all of them but the five species of *brevicornis* group of *Sphyracephala* Say (three Palearctic and two Nearctic ones) frequent tropic and the warmest subtropic areas, however the thermophilous Diopsidae are known in the New World neither in past nor in contemporary fauna.

Key words: Diptera, Phoridae, Diopsidae, scuttle flies, stalk-eyed flies, Rovno amber, Baltic amber, Late Eocene.

Новые находки представителей родов *Triphleba* (Phoridae) и *Prosphyracephala* (Diopsidae) в ровенском и балтийском янтарях. Перковский Е. Э., Мостовский М. Б., Хендерикс Х. — Двукрылые насекомые составляют 51 % членистоногих ровенского янтаря. Из ровенского янтаря описаны 99 видов и 23 рода двукрылых, однако на сегодняшний день из него указано лишь 32 вида, общих с фауной балтийского янтаря, включая два вида, рассмотренных в данной статье. *Triphleba schulmanae* Brown, 2003 (Phoridae), описанная из балтийского янтаря, впервые отмечена в ровенском янтаре и переописана. Род *Prosphyracephala* Hennig, 1965, ранее известный из балтийского и саксонского янтарей, верхнего эоцена Руби-Ривер (Монтана, США) и нижнего олигоцена Сересте (Франция), впервые отмечен в ровенском янтаре. *Prosphyracephala* aff. *succini* (Loew, 1873) и является первой находкой стебельчатоглазых мух на Украине. Второй экземпляр *Prosphyracephala kerneggeri* Kotrba, 2009 обнаружен в балтийском янтаре; впервые описано жилкование этого вида. Теплолюбивые диопсиды составляют подавляющее большинство видов семейства в Старом Свете; собственно, все виды тропические или обитают в очень тёплых субтропиках, за исключением 5 видов группы *brevicornis* рода *Sphyracephala* Say; в то же время из Нового Света термофильные диопсиды неизвестны.

Ключевые слова: Diptera, Phoridae, Diopsidae, мухи-горбатки, стебельчатоглазые мухи, ровенский янтарь, балтийский янтарь, поздний эоцен.

Introduction

Out of 32,300 imagos and larvae of Rovno arthropods, dipterans constitute 51 % (cf. 50 % in the representative collection, Perkovsky et al., 2007). Among 213 species and 48 genera of the Arthropoda described from the Rovno Amber by 2015, the Diptera account for some 45 %. Out of 99 dipteran species and 23 genera originally described from the Rovno Amber, none has been found so far in the Baltic Amber. It is more difficult to assess representation of the Baltic species in the fauna of the Rovno Amber. There are 26 such species out of 30 among the biting midges (Perkovsky, 2013; the total number of biting midges will undoubtedly grow once the Rovno material is better studied). Among the well-studied non-biting midges of the tribe Tanytarsini, there is only one common species (there are seven species in five genera known altogether, including four species in two genera in the Rovno Amber; Giłka et al., 2013; Zakrzewska, Giłka, 2014); the gall-midges do not have common species with the Rovno fauna at all. All in all, 30 dipteran species (including provisionally identified *Sycorax prompta* Meunier, 1905 (Azar et al., 2013)) described from the Baltic Amber have been recorded from Rovno amber until now.

One may surmise that the Rovno fauna should include at least 50 % of species that are common to both resins, as suggested by much better studied ants (Dlussky, Rasnitsyn, 2009; Radchenko, Perkovsky, 2009; Radchenko, Dlussky, 2012, 2013; Dlussky, Dubovikoff, 2013; Dlussky, Radchenko, 2013). We suppose that at least 70 additional Diptera species known from the Baltic Amber, are to be found in Rovno.

As regards the brachyceran Diptera, to date only the Campichoetidae *Pareuthychoeta minuta* (Meunier, 1906) previously known from the Baltic Amber has been recorded in the Rovno fauna (Perkovsky, 2011); empidid *Hemerodromia grootaerti* Plant et Shamshev, 2012 (Plant et al., 2012) and microbombyliids *Glabellula aggregata* Evenhuis, 2013, *Glabellula perkovskyi* Evenhuis, 2013, *Carmenelectra shehuggme* Evenhuis, 2013 and *Riga toni* Evenhuis, 2013 (Evenhuis, 2013) have been described as endemics to the Rovno Amber.

All Rovno amber specimens are housed in the Schmalhausen Institute of Zoology of the National Academy of Sciences of Ukraine (SIZK). Baltic amber specimens are housed in the collection of Hans Henderickx, Mol (HH). Photographs of SIZK specimens were taken by Alexandr P. Rasnitsyn at the Paleontological Institute, Russian Academy of Sciences, Moscow, using a Leica M 165 microscope and Leica DFC 425 camera; photographs of HH specimen made with Canon 5D mark III, objective MP-E 65 mm with stacking imaging.

Family PHORIDAE

The scuttle flies of the Rovno Amber have not been subjected to a specialist study so far, except for the analysis of their correlation with other arthropods in syninclusions (Perkovsky, Rasnitsyn, 2013). The Baltic Amber Phoridae are reasonably well known (e. g., Evenhuis, 1994; Brown, 1999, 2005, 2009, 2013), though the genus *Triphleba* is represented by only a handful of species (Evenhuis, 1994; Brown, 2003, 2005), with one being now discovered in the Rovno Amber.

Genus ***Triphleba*** Rondani, 1856
Triphleba schulmanae Brown, 2003 (fig. 1, a–c)

Material. SIZK K-27673, male, Klesov, Rovno amber, Late Eocene.

Amended description. Body length 1.8–1.9 mm. Overall colour brown. Frons with seven pairs of bristles, lower SA minute, only 0.25 as long as upper SA. Antenna bifurcate, setose. Arista dorsal with sort pubescens. Palpus short, 0.18 mm, with 7–10 setae. Thorax with 1 *h*, 5 *npl*, 1 *sa*, 1 *dc* (short prescutellar pair); 2 pairs of strong scutellars. Tibial setation as follows: tb_1 4–5 *a* or *ad*; tb_2 1 *a* in basal quarter, 2 *d* in basal third; tb_3 1 *a* at end of basal third, 1 *ad* at midlength, 5(–6) *d* in distal half. Wing length 1.43 mm. Costal index 0.55. Costal ratios 3.3 : 0.8 : 1. Costal cilia 0.04 mm. R_{2+3} fork elongate. All abdominal tergites fully developed, at most with short sparse hairs. Male genitalia with narrow epandrial process on each side.

Remarks. In the specimen on hand, the terminalia are somewhat concealed, as in the holotype, and cannot be examined.

Family DIOPSIDAE
Subfamily DIOPSINAE

The Diopsidae, or stalk-eyed flies, is a comparatively small acalyptrate family of nearly 200–300 species in 11 to 14 genera (Feijen, 1989). The family is remarkable for having most

species with hypercephalic features and exhibits the greatest diversity in the Old World, particularly in the tropical and subtropical parts of Africa followed by Southeast Asia, with few species in the Palaearctic Region (Papp et al., 1997; Hauser et al., 2011). Two species are known in the temperate eastern North America, with one of them being recorded as far west as Wyoming (Stoaks, Shaw, 2011).

Genus ***Prosphyracephala*** Hennig, 1965

The first diopsid specimen in the Rovno Amber (fig. 1, *d*, *e*) belongs to the extinct genus *Prosphyracephala* Hennig, 1965 known in the Baltic Amber only from two species, *Pros-*

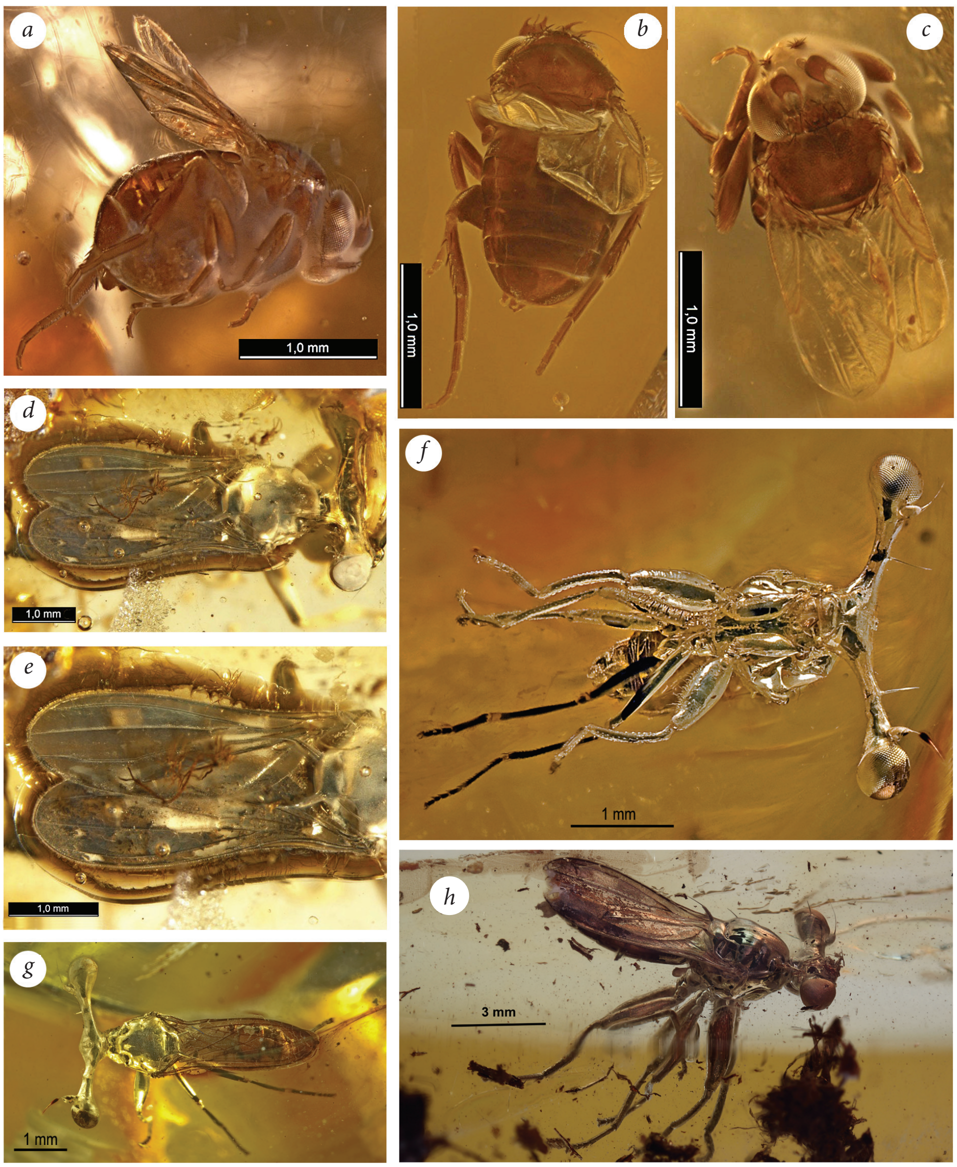


Fig. 1. *Triphleba schulmanae*: *a* — lateral view, *b* — dorsal view, *c* — anterodorsal view, with exposed bifurcate antennae; *Prosphyracephala* aff. *succini*: *d* — habitus, *e* — wings; *Prosphyracephala kerneggeri*: *f* — ventral, g — dorsal; *Prosphyracephala succini*: *h* — habitus.

Рис. 1. *Triphleba schulmanae*: *a* — вид сбоку, *b* — вид сверху, *c* — вид спереди и сверху, показаны раздвоенные антенны; *Prosphyracephala* aff. *succini*: *d* — общий вид, *e* — крылья; *Prosphyracephala kerneggeri*: *f* — вид снизу, *g* — вид сверху; *Prosphyracephala succini*: *h* — общий вид.

phyracephala succini (Loew, 1873) found also in Bitterfeld and Céreste (Schumann, 1994; Lutz, 1985) and *Prosphyracephala kerneggeri* Kotrba, 2009 (Kotrba, 2009); old records of 'amber' insects in Oligocene sedimentary deposits are usually referred to misidentifications, hence the Céreste record is of special importance. *Prosphyracephala rubiensis* Lewis, 1971 known from the Mormon Creek (Ruby River, the upper part of the Upper Eocene of Montana (Lewis, 1971; McHugh, 2003).

Prosphyracephala* aff. *succini (Loew, 1873) (fig. 1, *d*, *e*)

M a t e r i a l . SIZK K-25549, sex unknown, Klesov, Rovno amber, Late Eocene. Syninclusions: K-25549a, Acari, spiderweb, numerous stellate hairs; K-25550, leg of Cicadinea, Oribatei.
The specimen was obtained on Ukramber factory (Rovno) and was found in the Pugach quarry.

The external eye to eye distance (which is used as a parameter for the eye-stalk length) of the Rovno specimen is 2.50 mm, fitting in the ratio of *P. succini* (Kotrba, 2004). Also the overall habitus directs to this species. However, a micro-CT scan might perhaps reveal optically blurred details with more information, so it would be better to determine this specimen tentatively as *Prosphyracephala* aff. *succini*, especially because this Rovno specimen has a different origin than the Baltic specimens. It is the first record the Diopsidae from the Ukraine.

Prosphyracephala succini (Loew, 1873) (fig. 1, *h*)

M a t e r i a l . HH Diopsidae *P. succini* (fig. 1, *h*), male, Yantarnyi, Baltic amber, Late Eocene.

Prosphyracephala kerneggeri Kotrba, 2009 (fig. 1, *f*; *g*, 2)

M a t e r i a l . HH Diopsidae *P. kerneggeri* (fig. 1, *f*), sex unknown, Baltic amber, Late Eocene. The specimen was obtained from a Lithuanian dealer and had been probably found in Yantarnyi.

R e m a r k s . Previously, *P. kerneggeri* was known only from the holotype with missing wing parts. A second, recently found complete specimen of *P. kerneggeri* (fig. 1, *g*), enables a wing venation drawing of this species to be completed (fig. 2).

Representatives of the genus *Prosphyracephala* are rare in fossil resins; there are no diopsids in representative collections of the Baltic Amber (The amber.., 2001; Sontag, 2003; Perkovsky et al., 2007), although 24 *Prosphyracephala* specimens have been recorded so far from the Baltic Amber and four from Bitterfeld (Schumann, 1994; Kotrba, 2009).

There is no alula seen on the photo of *P. rubiensis*, the position of the antenna base is indistinguishable from that in other *Prosphyracephala* (Lewis, 1971), and there are no reasons to doubt its assignment to this genus (Feijen, 1989).

The average temperature of the coldest month at the northernmost range of the modern distribution of the stalk-eyed flies in Europe (Szeged, Hungary) is –2 °C (Papp et al., 1997). It has been hypothesised that winters were not harsher in the Baltic Amber forest (Archibald, Farrell, 2003). The average January temperature at the Mormon Creek has been calculated as –0.6 °C (standard deviation 3.6 °C; Lielke et al., 2012); while the mean annual temperature (MAT) in that North American locality has been postulated as 14 ± 2.4 °C, which is higher than in Szeged (9.5 °C).

Worth mentioning is that the vast majority of the Old World Diopsidae are strictly thermophilous. In fact, all of them but the five species of *brevicornis* group of *Sphyracephala* Say (three Palearctic and two Nearctic ones) frequent tropic and the warmest subtropic areas. The thermophilous Diopsidae are known in the New World neither in past nor in contemporary fauna. Concerning the two living Nearctic species of *brevicornis* group, all records of one of them and 97 % of another made north of the January isotherm +5 °C (Feijen, 1989).

Eocene Arctic fossil floras indicate that temperate (i.e., upper microthermal to lower mesothermal) conditions predominated across intercontinental connections, with early to middle Eocene floras from Greenland and Axel Heiberg Island (50–40 Myr ago) giving MAT estimates of 12–16 °C (Archibald et al., 2011), probably too cool to support dispersal

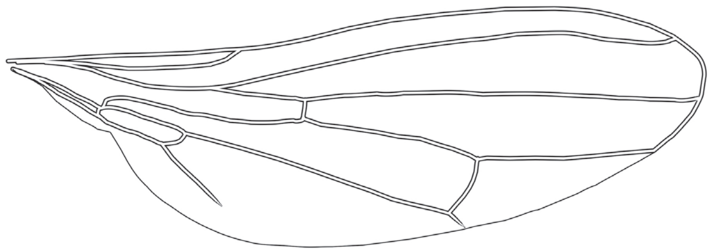


Fig. 2. A wing of *Prosphyracephala kerneggeri.*

Рис. 2. Крыло *Prosphyracephala kerneggeri.*

of thermophilous Diopsidae. During larger global hyperthermal events linked to injection of greenhouse gasses into the atmosphere from sedimentary reservoirs, Arctic MAT increased by 5–10 °C to perhaps approximately 23 °C with the coldest month mean temperature greater than 8 °C at approximately 85° N palaeolatitude. Three warming events are suggested, the brief Palaeocene–Eocene Thermal Maximum at the Palaeocene–Eocene boundary (approx. 170 kyr long at about 55.5 Ma); the Eocene Thermal Maximum 2 (about 53.5 Ma); and the longer Early Eocene Climatic Optimum, about 2 Myr long at the latest early Eocene. One of these maxima made possible the giant Formiciinae ants to invade North America (Archibald et al., 2011).

The diopsid invasion probably occurred later than the above one, possibly during the Middle or, rather, Late Eocene, with no macrothermal routes preserved, and with only survived those available for Diopsidae with the winter diapause (Feijen, 1989; Papp et al., 1997). This would limit the diopsid dispersion even to warmer New World subtropics, not to mention the tropics.

Authors' responsibilities. MBM is responsible for the redescription of *Triphleba schulmanae*, HH for the wing description of *Prosphyracephala kerneggeri* and for identification of the Rovno diopsid fossil, and EEP for the remaining text.

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